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Mozzati et al.

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(54) **BRAKE DISC**

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(51) **Int. Cl.**
F16D 65/12 (2006.01)

(52) **U.S. Cl.** ..... **188/218 XL**; 188/17

(58) **Field of Classification Search** ..... 188/17, 188/18 A, 26, 218 XL
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,987,143	A *	6/1961	Fuchs et al.	188/71.5
4,821,848	A *	4/1989	Izumine	188/218 XL
4,848,521	A *	7/1989	Izumine	188/18 A
5,139,117	A	8/1992	Melinat	
5,520,269	A *	5/1996	Yamamoto et al.	188/218 XL
5,850,895	A *	12/1998	Evrard	188/264 A
6,206,144	B1 *	3/2001	Di Bella	188/26
6,305,510	B1 *	10/2001	Bunker	188/218 XL
6,386,340	B1 *	5/2002	Milesi et al.	188/218 XL
6,957,726	B2 *	10/2005	Gehrs	188/218 XL
7,007,776	B1 *	3/2006	Lin	188/24.22

FOREIGN PATENT DOCUMENTS

DE	2217009	10/1973
DE	29910528	9/1999
EP	1048874	11/2000
WO	01/86166	11/2001

* cited by examiner

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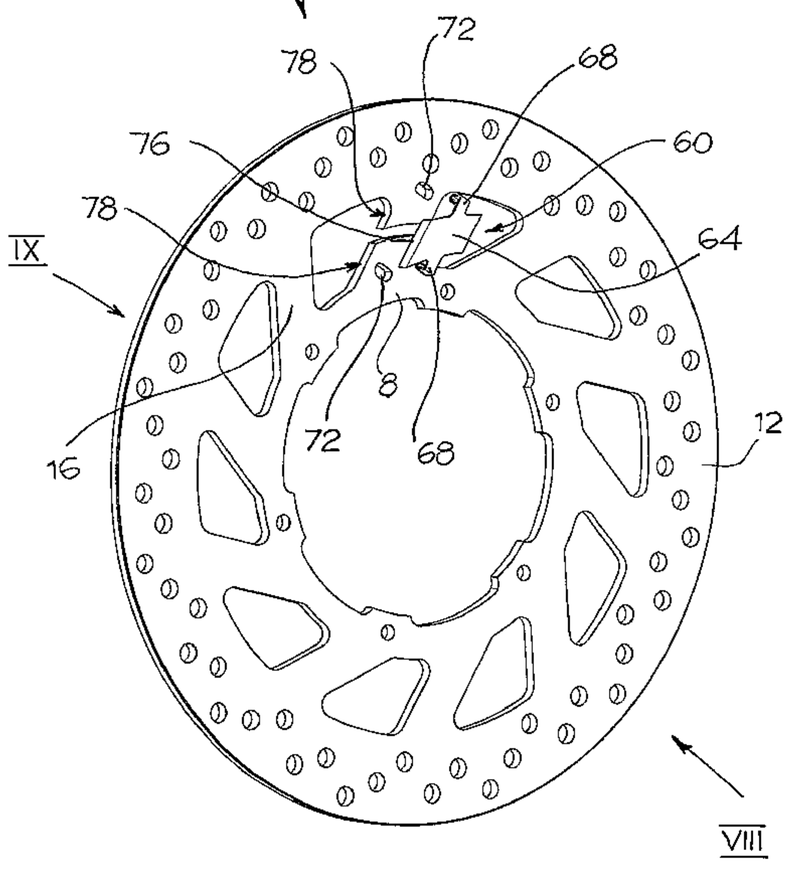
(57) **ABSTRACT**

A brake disc of the type comprising a braking band, a connecting portion and connecting spokes made in a single piece. In said disc at least one spoke exhibits an active section reduction that is sufficient to prevent vibrations and whistling during the braking phase. The disc, according to the present invention, is not subject to vibrations and possesses a limited gyroscopic effect and mass.

21 Claims, 13 Drawing Sheets



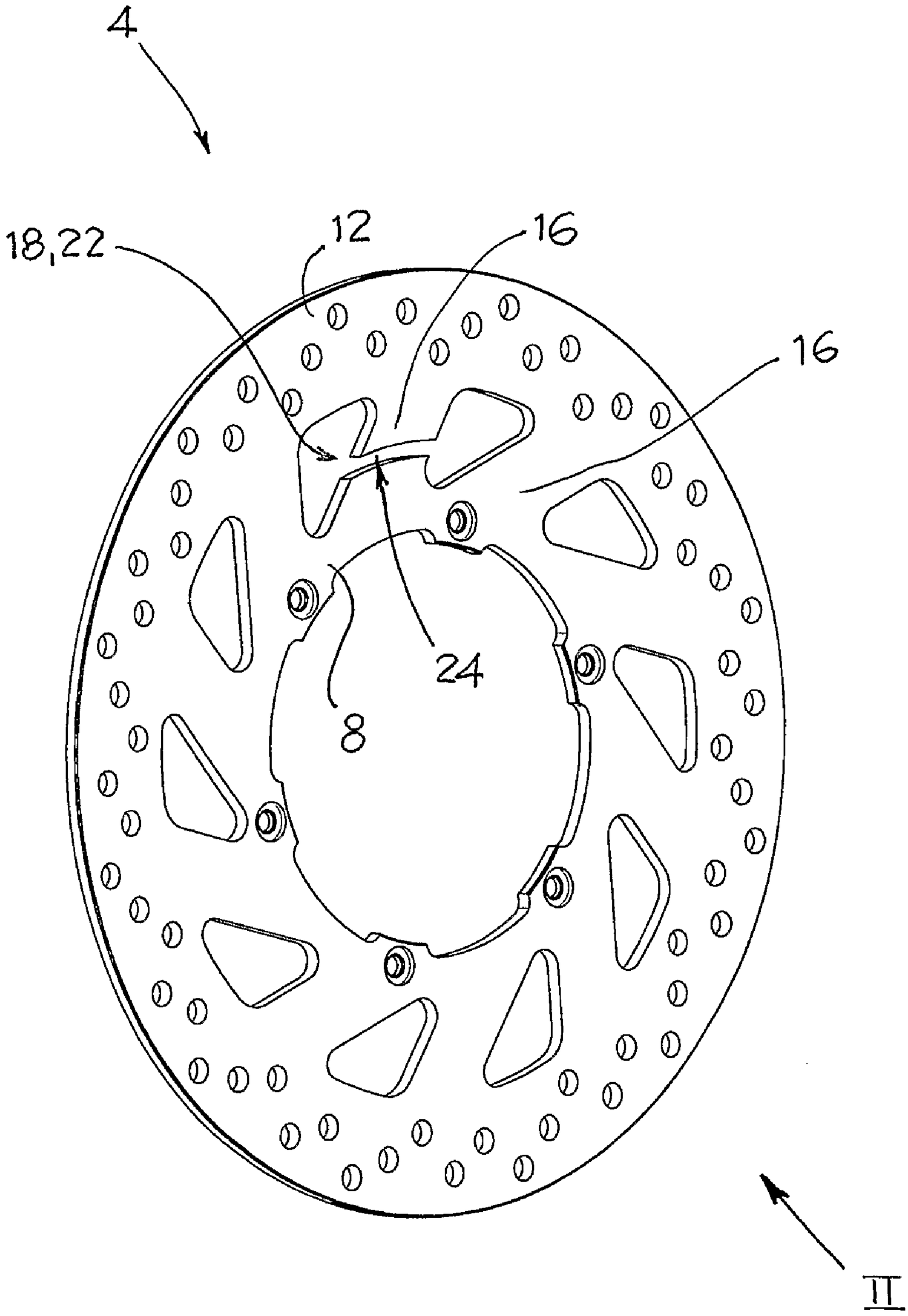


Fig. 1

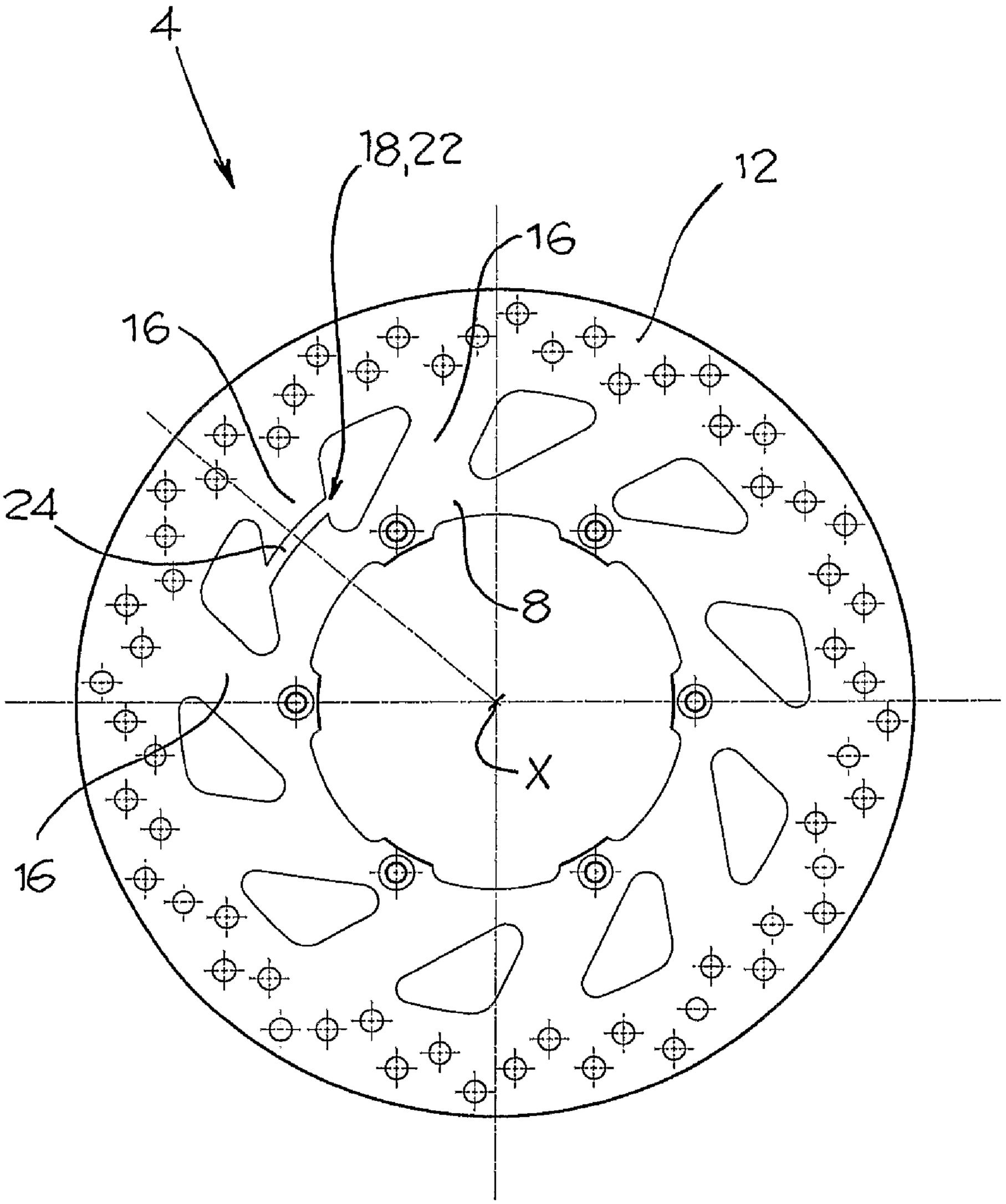


Fig. 2

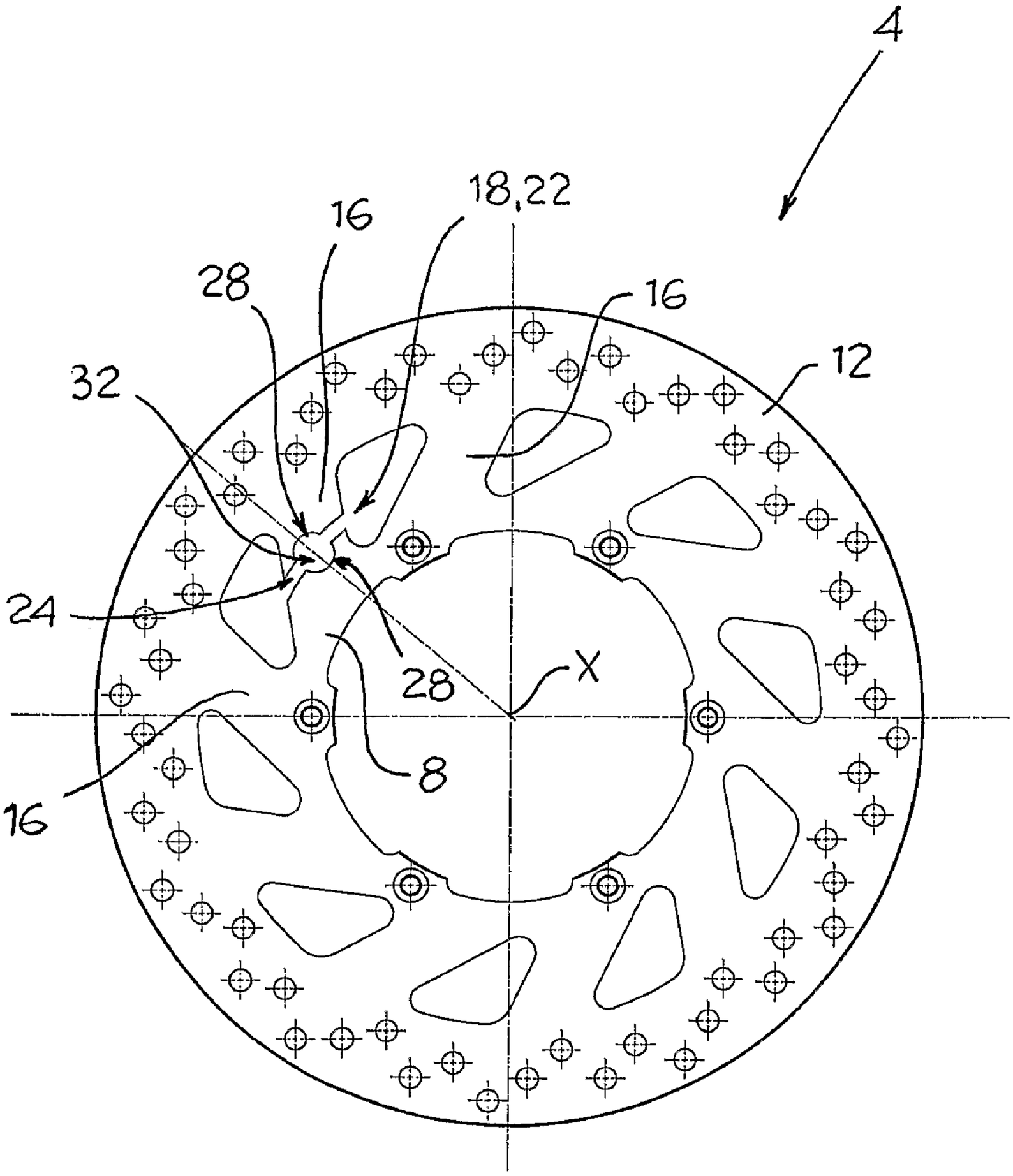


Fig. 3

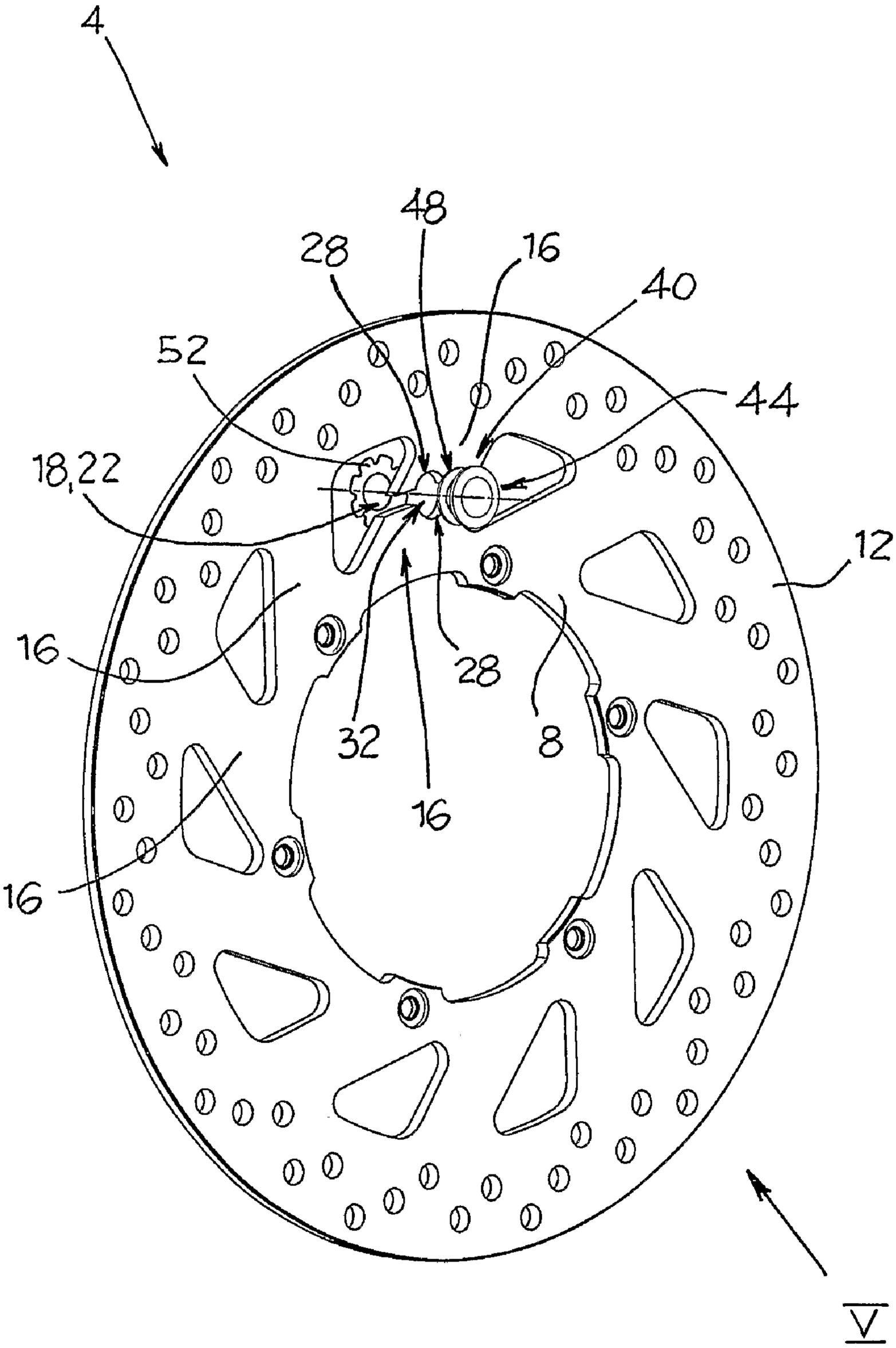


Fig. 4

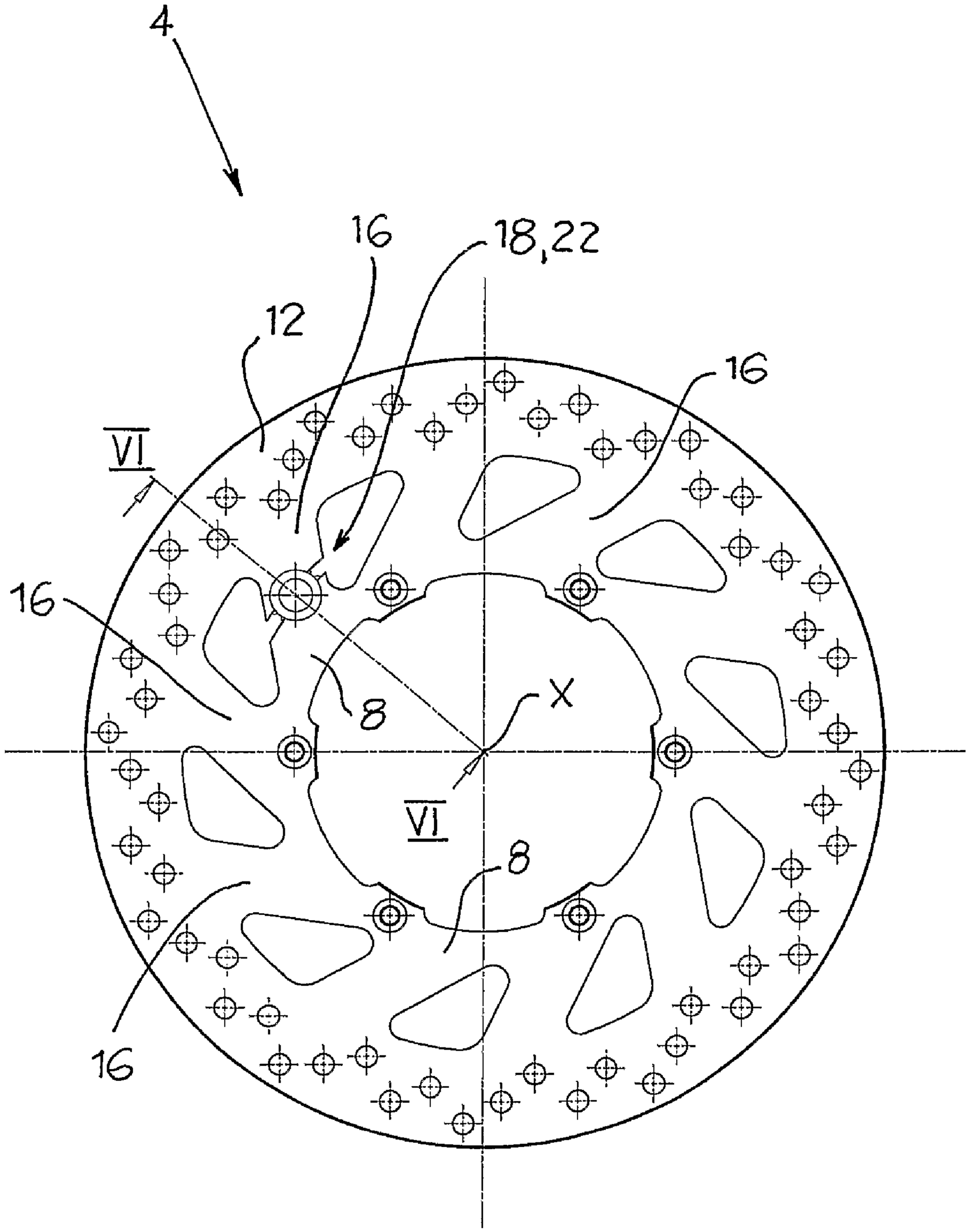


Fig. 5

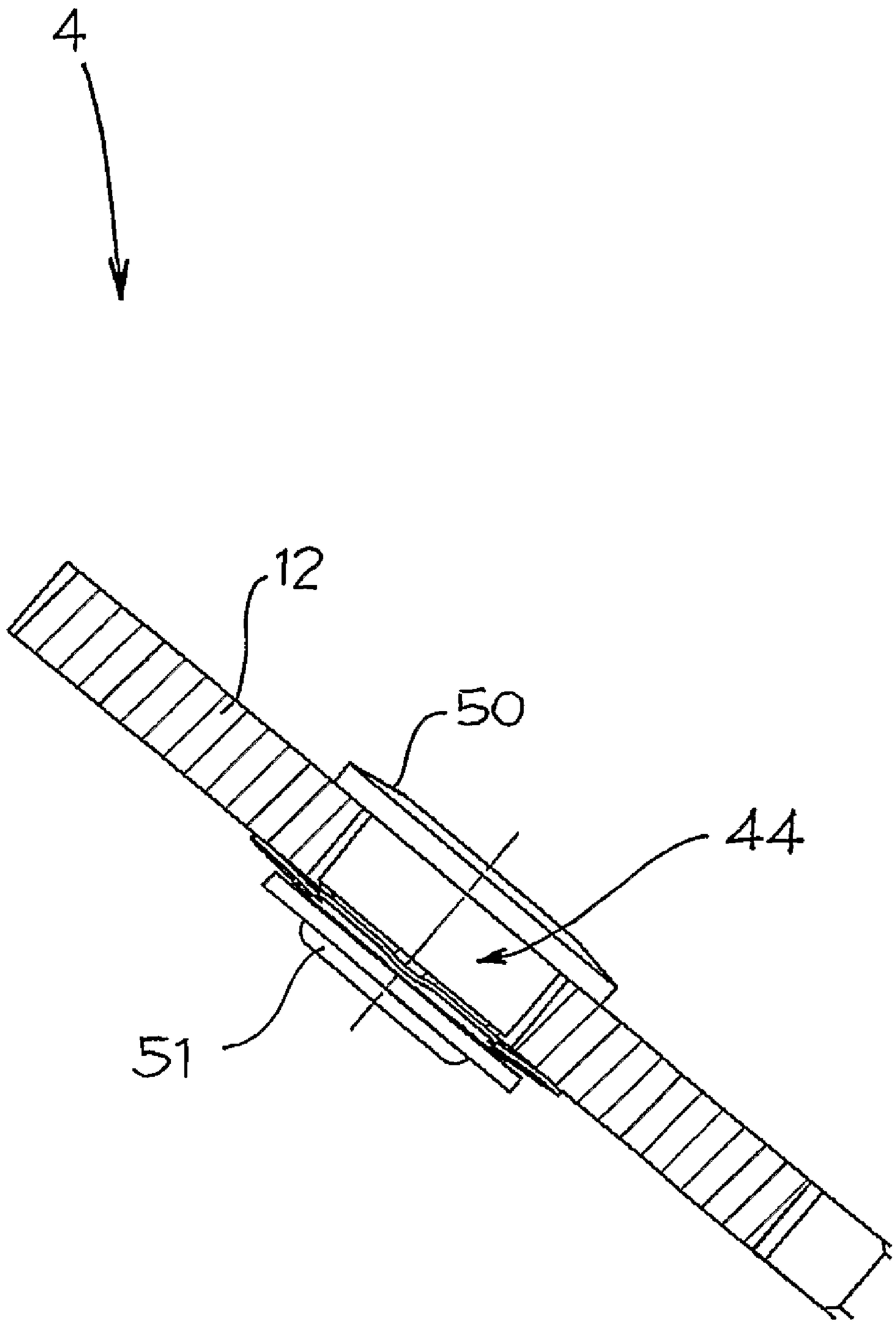


Fig. 6

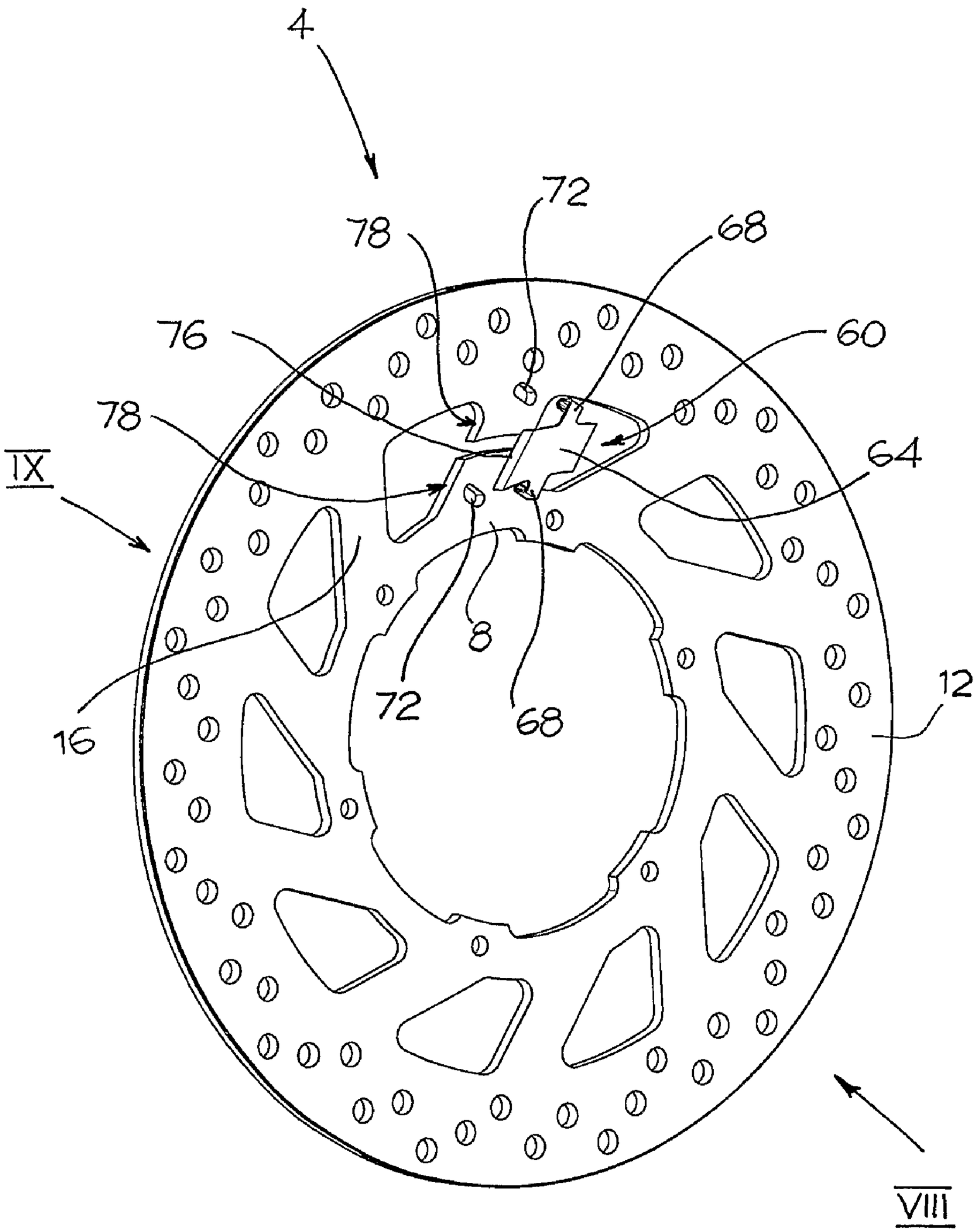


Fig. 7

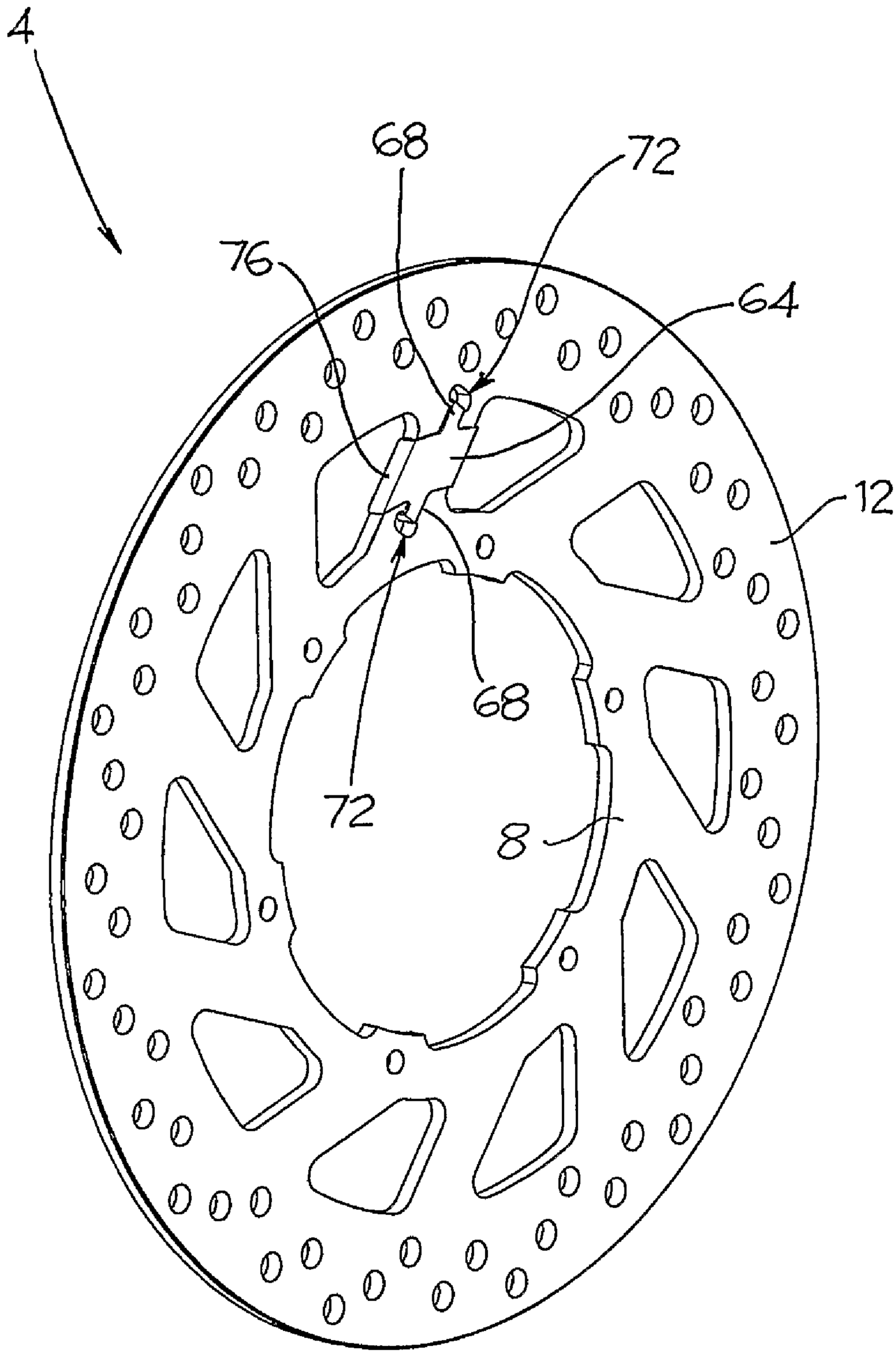


Fig. 8

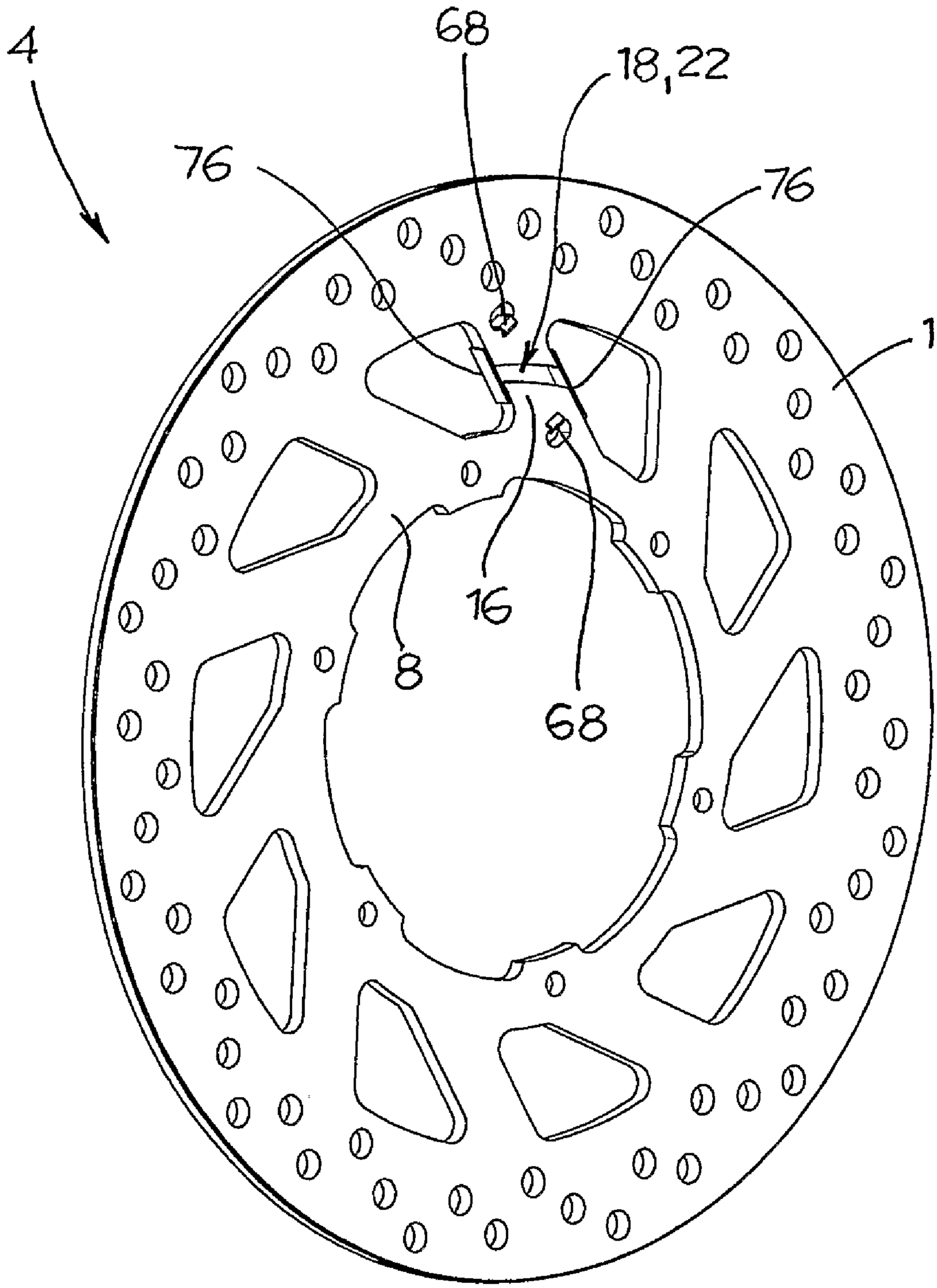
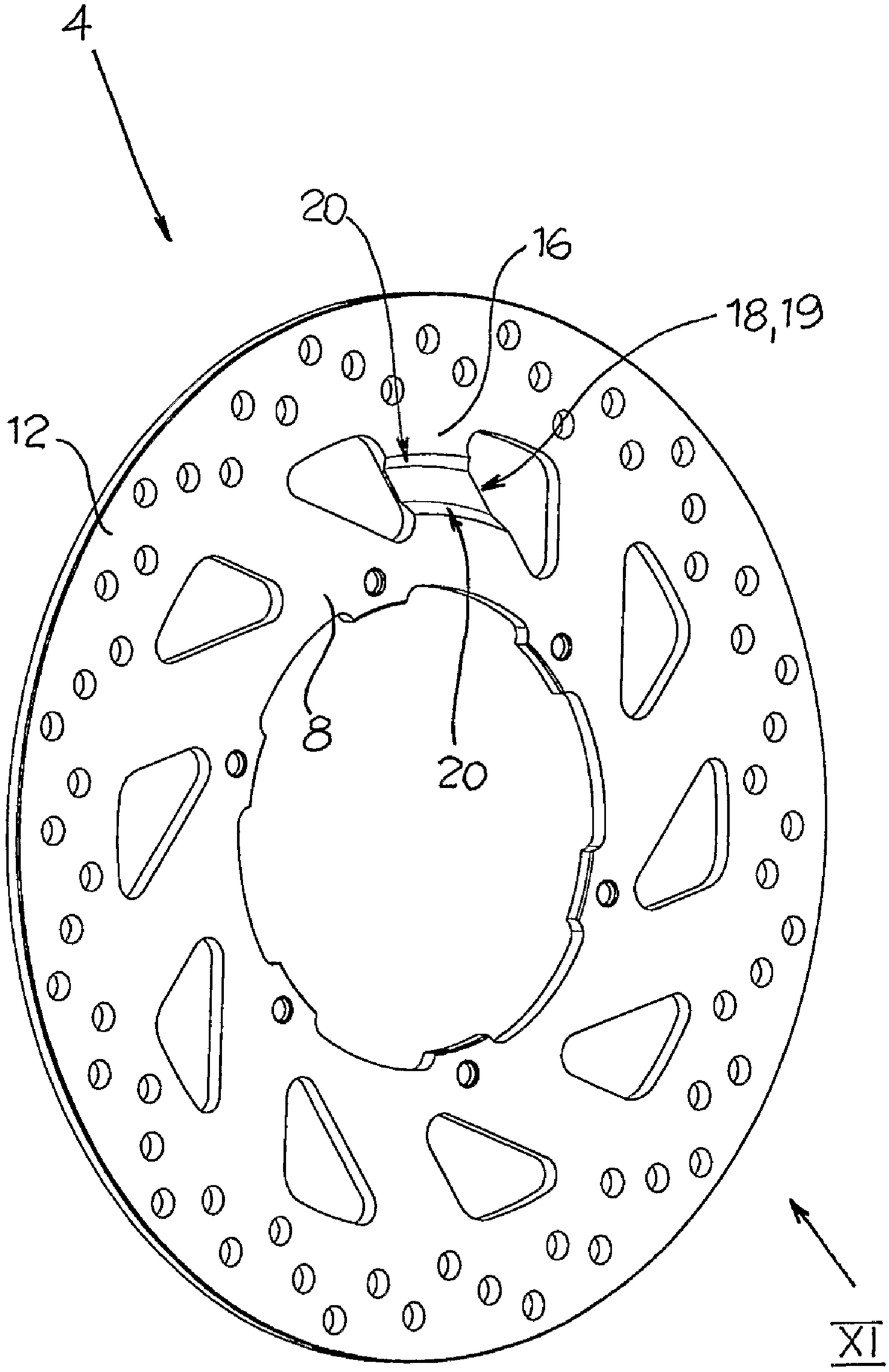


Fig. 9



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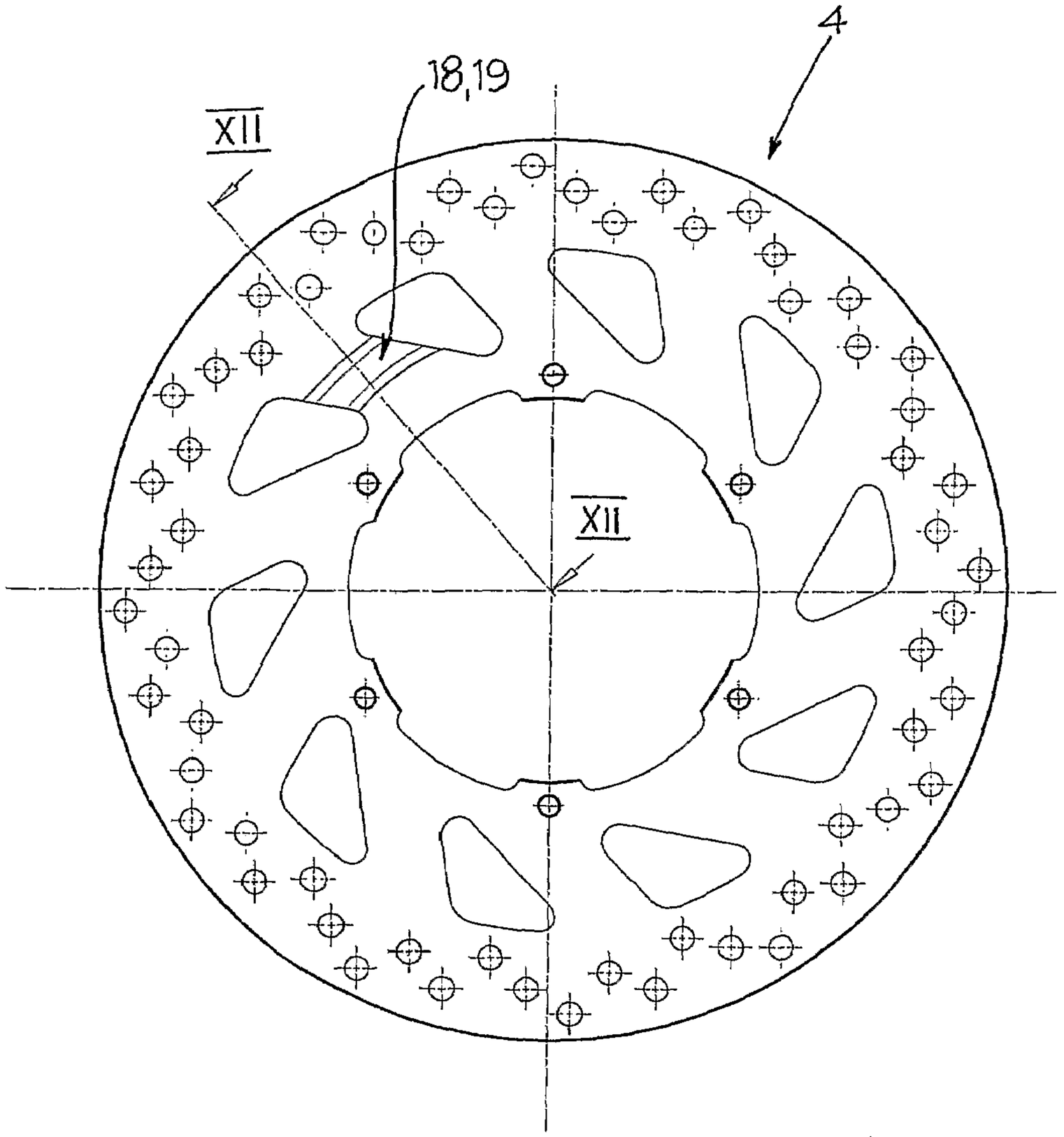

Fig. 11

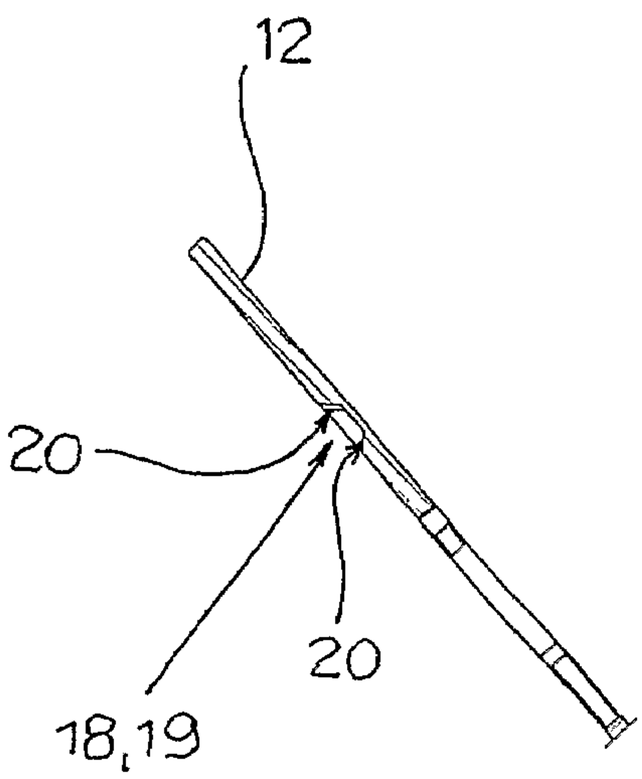

Fig. 12

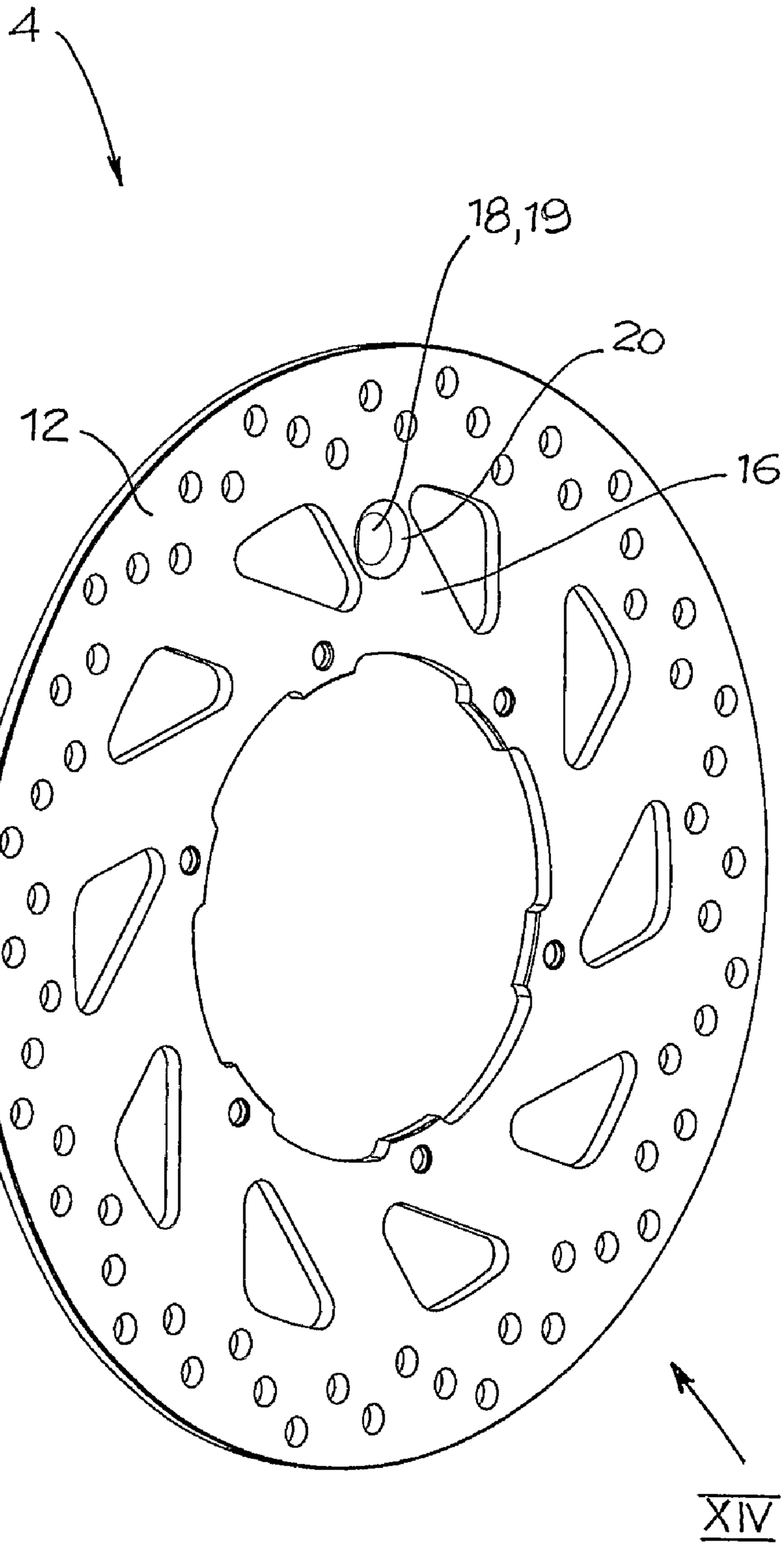

Fig. 13

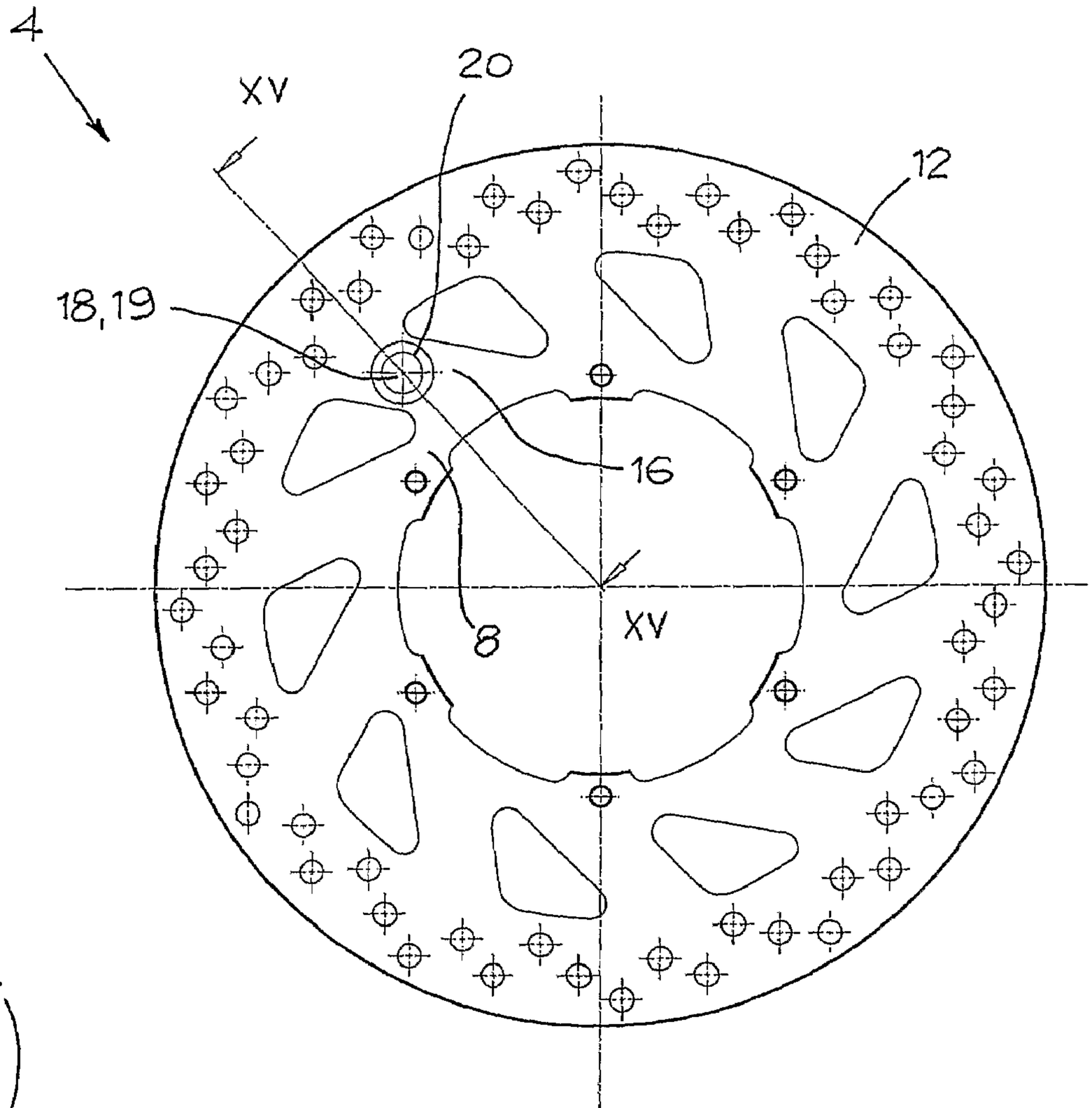

Fig. 14

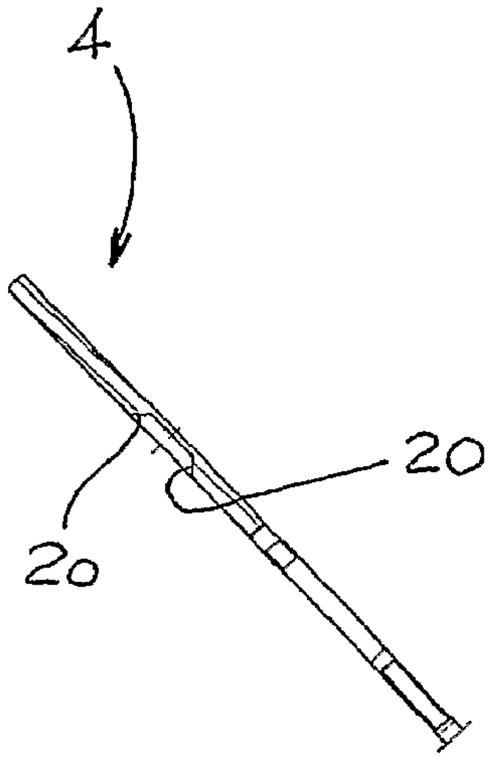

Fig. 15

BRAKE DISC

FIELD OF THE INVENTION

The present invention relates to a brake disc for vehicles; in particular, the present invention relates to brake discs that are suitable for being used on motorcycles.

BACKGROUND OF THE INVENTION

As we know, in some motorcycles the front or back wheels often comprise an integrally formed brake disc, in other words comprising a portion for connecting to the hub, a braking band and a plurality of spokes made in a single piece.

During braking, these brake discs may suffer vibrations that cause an irritating whistling.

Solutions suitable for eliminating this inconvenience are not known in the art.

SUMMARY OF THE INVENTION

The problem of the present invention is to make a brake disc for vehicles that resolves the inconveniences stated with reference to the prior art.

These inconveniences are resolved by a brake disc for vehicles as described below.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the present invention will be appreciated from the following description of a preferred embodiment, wherein:

FIG. **1** represents a perspective view of a brake disc according to an embodiment of the present invention;

FIG. **2** represents a front view of the disc in FIG. **1**, from the side of the arrow II in FIG. **1**;

FIG. **3** represents a front view of a brake disc according to a further embodiment of the present invention;

FIG. **4** represents a perspective view with separate parts of a disc according to a further embodiment of the present invention;

FIG. **5** represents a front view of the disc in FIG. **4**, from the side of the arrow V in FIG. **4**;

FIG. **6** represents a section view of the disc in FIG. **5**, along the VI-VI section line in FIG. **5**;

FIG. **7** represents a perspective view with separate parts of a brake disc according to a further embodiment of the present invention;

FIG. **8** represents a perspective view of the disc in FIG. **7** in an assembly configuration, from the side of the arrow VIII in FIG. **7**;

FIG. **9** represents a perspective view of the disc in FIG. **7** in an assembly configuration, from the side of the arrow IX in FIG. **7**;

FIG. **10** represents a perspective view of a disc according to a further embodiment of the present invention;

FIG. **11** represents a front view of the disc in FIG. **10**, from the side of the arrow XI in FIG. **10**;

FIG. **12** represents a section view of the disc in FIG. **10**, along the XII-XII section line in FIG. **11**;

FIG. **13** represents a perspective view of a disc according to a further embodiment of the present invention;

FIG. **14** represents a front view of the disc in FIG. **13**, from the side of the arrow XIV in FIG. **13**;

FIG. **15** represents a section view of the disc in FIG. **13**, along the XV-XV section line in FIG. **14**.

DETAILED DESCRIPTION OF THE INVENTION

The elements or parts of elements in common between the subsequently described embodiments will be indicated with the same numeral references.

The term radial direction means a direction that is substantially perpendicular to an X rotation axis of the disc.

The term axial direction means a direction that is substantially parallel to the X rotation axis of the disc.

The term tangential direction means a direction that is substantially perpendicular to the axial direction and to the radial direction.

With reference to the above drawings, a brake disc for vehicles with an X rotation axis is generally indicated with reference numeral **4**.

The brake disc **4** comprises a connecting portion **8** to a wheel hub of a vehicle, a braking band **12** and at least one spoke **16** interconnecting the connecting portion **8** and the braking band **12**.

The braking band **12** is preferably connected to the connecting portion **8** by means of a plurality of spokes **16** that are preferably arranged in step.

The brake disc **4** is formed integrally, in particular, the braking band **12** is integral with the connecting portion **8** and with the spokes **16**.

Advantageously, at least one spoke **16** comprises an active section reduction **18** to provide reduced rigidity in relation to the corresponding integral section.

According to an embodiment of the present invention, the section reduction **18** is made with a lightening **19** that is suitable for reducing the axial thickness of a portion of the spoke.

According to one embodiment (FIGS. **11**, **12**), the lightening **19** has a tangential course that is sufficient to influence the whole tangential width of the spoke **16**. The lightening **19** can be defined by one or more chamfers or flares **20**, which are arranged tangentially and parallel between each other.

According to a further embodiment (FIGS. **13-15**), the lightening **19** has a circular course defining a cylindrical pocket.

The lightening **19** with a circular course is preferably defined by a chamfer or flare **20** arranged on the side of one face of the disc.

The lightening **19** preferably limits the active section of the spoke **16** to maintain the continuity, level with said spoke **16**, between the connecting portion **8** and the braking band **12**. In other words, the lightening **19** reduces the active section of the spoke **16** but does not completely interrupt the continuity of the same spoke, or rather the mechanical connection that the spoke forms between the braking band **12** and the connecting portion **8**.

The lightening **19** preferably reduces the active section of the spoke **16** to no more than 40% of the active section of the integral spoke **16**. In other words, the lightening **19** reduces the active section of the spoke **16** by at least 60% compared with the corresponding section of the integral spoke **16**.

According to an advantageous embodiment (FIGS. **1-5**), the section reduction **18** creates an interruption **22** of the spoke **16** so as to divide the spoke **16** into two parts and interrupt the continuity between the connecting portion **8** and the braking band **12**.

According to an embodiment, the interruption **22** is arranged level with a portion of the spoke **16** next to the braking band **12**.

According to an embodiment, the interruption **22** comprises a direct channel **24** that is substantially tangential to the braking band **12** so as to affect the whole tangential thickness of the spoke **16** dividing it into two separate parts.

The interruption **22** preferably comprises at least one indentation **28** in relation to a radial direction, which is suitable for defining a slot **32** with said channel **24**.

According to an embodiment, the interruption **22** comprises a pair of indentations **28** that are radially facing and arranged on each of the ends of the opposite portions of the spoke **16** facing each other, the indentations **28** defining a slot **32** with the channel **24**.

The slot **32** is preferably symmetrical in relation to a radial direction passing the X rotation axis of the disc **4**.

The slot **32** is also preferably symmetrical in relation to a tangential direction, perpendicular to a radius of the disc.

According to an advantageous embodiment, the disc **4** comprises at least one bush **40** contained in the slot **32** and the channel **24** so it is constrained by the indentations **28** in relation to a tangential direction.

According to an embodiment, the bush **40** comprises a bush body **44** and constraining means **48**. According to an embodiment the bush **40** is formed integrally and level with an axial end, said constraining means comprise a first head **50**, and at the opposite end they comprise a second head **51**, which is obtained, for example, by riveting. These heads **50**, **51** exhibit a greater diameter than the diameter of the slot **32** so as to axially constrain the bush **40** in relation to the slot **32**.

An elastic element **52** is preferably inserted between the bush body **44** and one of the heads **50**,**51**, suitable for pre-charging the bush body **44** and the constraining means **50**,**51** in relation to an axial direction.

According to an embodiment, said elastic element **52** is a washer spring.

The mass of the bush **40** is preferably substantially equal to the mass of material removed from the spoke **16** to form the interruption.

According to a further embodiment, the disc comprises at least one small plate **60** suitable for being connected to the slot **32** or the channel **24** so as to cover the interruption **22** at least partially.

The small plate **60** preferably has a plate body **64**, for example that is flat and equipped with a pair of fastening flaps **68** that are suitable for being constrained by clicking or mortising to special fastening holes **72**, which are arranged, for example, on the spoke on the side of the connecting portion **8** and the braking band **12**.

According to an embodiment, the plate body **64** comprises two flaps **76** suitable for being hooked by clicking onto side edges **78** of the spoke, which are separated by the interruption **22**.

The plate body **64** preferably has a tangential extension so as to completely cover the interruption **22**.

The mass of said plate **60** is preferably substantially equal to the mass of material removed from the spoke **16** to form the interruption **22**.

Advantageously, in an assembly configuration of the disc **4** on the relative wheel hub, the disc is oriented angularly to bring the interruption **22** and the connectable bush **40** or plate **60** into a diametrically opposite position in relation to the inflation valve of the relative tyre to be connected to the rim.

According to a further embodiment, at least two spokes **16** of the disc **4** comprise an active section reduction **18** to exhibit reduced rigidity in relation to the corresponding integral section.

Said active section reduction **18** can be made with a lightening **19** or an interruption **20**. In an embodiment comprising two spokes **16**, with an active section reduction **18**, said spokes **16** are preferably arranged in diametrically opposite positions in relation to said X rotation axis of the disc **4**.

In an embodiment comprising at least two spokes **16** or a plurality of spokes **16**, comprising an active section reduction **18**, the spokes **16**, comprising an active section reduction **18** are preferably arranged in step in relation to the X rotation axis.

As we can appreciate from the description, the brake disc of the present invention enables the inconveniences exhibited by the brake disc of the prior art to be overcome.

In particular, the disc according to the invention does not vibrate and whistle during braking.

The disc in the present invention maintains a gyroscopic effect, as well as a reduced, non suspended mass.

In order to satisfy specific and contingent needs, a person skilled in the art can make numerous modifications and variations to the above described brake discs, all of which are included in the scope of the invention, as defined by the following claims.

We claim:

1. Brake disc with a rotation axis, said disc comprising
a hub connecting portion for connection to a hub,
a braking band, and
a plurality of spokes interconnecting the braking band and the hub connecting portion,
said hub connecting portion, braking band and spokes being a single piece, wherein
at least one spoke has an interruption which divides the spoke into two parts, and interrupts continuity between the hub connecting portion and the braking band.

2. Brake disc according to claim **1**, wherein said interruption comprises a direct channel that is substantially tangential to the braking band, in relation to said rotation axis.

3. Brake disc according to claim **2**, wherein said interruption comprises at least one indentation in relation to a radial direction, which is suitable for defining a slot with said channel.

4. Brake disc according to claim **3**, wherein said disc comprises at least one bush contained in said slot and in said channel so it is constrained by said indentations in relation to a tangential direction.

5. Brake disc according to claim **4**, wherein said bush comprises a bush body and constraining means that are axially constrained between each other.

6. Brake disc according to claim **5**, wherein said constraining means comprise a first head and at an opposite end they comprise a second head, said heads having a greater diameter than the diameter of the slot so as to constrain the bush axially in relation to the slot.

7. Brake disc according to claim **6**, wherein an elastic element is inserted between said bush body and one of said heads, which is suitable for pre-charging the bush body and the constraining means in relation to an axial direction.

8. Brake disc according to claim **7**, wherein said elastic element is a washer spring.

9. Brake disc according to claim **4**, wherein the mass of said bush is substantially equal to the mass of material removed from the spoke to form said interruption.

10. Brake disc according to claim **3**, wherein said disc comprises at least one small plate contained in said slot or in said channel so as to cover said interruption at least partially.

11. Brake disc according to claim **10**, wherein the small plate comprises a plate body equipped with a pair of fastening flaps that are suitable for being constrained by clicking or mortising to special fastening holes in the disc.

12. Brake disc according to claim 11, wherein said fastening holes are arranged on the spoke on the side of the connecting portion and the braking band.

13. Brake disc according to claim 10, wherein the plate body comprises two flaps which can be hooked by clicking onto side edges of the spoke, which are separated by the interruption.

14. Brake disc according to claim 10, wherein the mass of said plate is substantially equal to the mass of material removed from the spoke to form said interruption.

15. Brake disc according to claim 3, wherein said slot is symmetrical in relation to a tangential direction, perpendicular to a radius of the disc.

16. Brake disc according to claim 3, wherein said slot is symmetrical in relation to a radial direction passing through the rotation axis of the disc.

17. Brake disc according to claim 2, wherein said interruption comprises a pair of indentations that are radially facing and arranged on ends of opposite portions of the spoke facing each other, said indentations defining a slot with said channel.

18. Brake disc according to claim 1, wherein at least two spokes of said disc comprise an interruption which interrupts continuity between the hub connecting portion and the braking band.

19. Brake disc according to claim 18, wherein said at least two spokes, comprising an interruption are arranged in diametrically opposite positions in relation to said rotation axis.

20. Brake disc according to claim 18, wherein said at least two spokes, comprising an interruption, are arranged in step in relation to said rotation axis.

21. Brake disc according to claim 1, wherein said interruption is level with a portion of the spoke next to the braking band.

* * * * *